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Remarks/Arguments

1. Claims 1-14 were pending at the time of examination. Examiner rejected all 14 claims. Applicant appreciates Examiner's careful review of the present application as evidenced by the Office Action of October 11, 2006, and requests reconsideration of the currently presented claims.

2. **Amendments to the Claims**: Claim 14 has been amended to recited oscillatory means that are prone to vibration. Oscillatory means that vibrate have been recited in claim 1. This amendment introduces no new subject matter and no new combination of subject matter that requires a new search. Applicant requests approval and entry of the amended claim.

3. **Rejections under 35 U.S.C. § 102(b):** Examiner rejected claims 1 and 7-13 as being anticipated by Branson, U.S. Patent 3,222,221. In section 1 on page 2 of the Office Action, Examiner asserts that Branson discloses all the elements of claims 1 and 7 – 13 of the present invention, and particularly, asserts that the "process flow is capable of causing the oscillatory means to vibrate."

4. Applicant will briefly describe the distinguishing features of the present invention, to provide a basis for discussing the rejections. The purpose of the present invention is to convert flow energy to acoustic energy for sanitizing liquids, and to do so without requiring an external energy source, or only an auxiliary energy source. Claim 1 of the present invention claims an acoustic energy device that creates turbulent flow and then uses that turbulent flow to cause oscillatory means to vibrate, thereby converting flow energy of the process liquid to acoustic energy that works on the process liquid. The turbulent flow of the process liquid is the energy source for the acoustic energy. The

entire device is a "transducer," in the sense that it converts flow energy to acoustic energy. The acoustic energy device of the present application does not require input of acoustic energy from acoustic transducers, not does it require the input of any energy, other than the flow energy of the process fluid, to create the acoustic energy.

5. The Branson apparatus is designed to clean small items, including gravel or very fine particulate matter. See Branson, FIG. 1 and col. 1, lines 13 – 16, col. 2, lines 63 – 65, and col. 4, lines 20 – 24. For reasons of simplicity, the term "gravel" shall be used hereinafter to designate the article to be cleaned in the Branson apparatus. Branson discloses an apparatus comprising a tank 10 with a chute 18 contained therein, and a plurality of ultrasonic transducers 22 mounted on the walls of the chute. The transducers may be electrostatic, piezoelectric, or magneto-restrictive devices. Branson, col.3, line 69 – col. 4, line 3, and FIGS. 1 – 3. The acoustic transducers defined by Branson all convert some type of electrical energy into sound energy, in other words, all require an external energizing source in order to produce the acoustic energy. Branson states that an ultrasonic generator is used to drive the transducers.

6. The flow of the cleaning fluid 12 in the tank is <u>not</u> used to force the transducers to oscillate, nor is it possible that the flow of the cleaning fluid itself in the Branson tank could generate the acoustic energy in the chute 18 by means of turbulent flow, as claimed in claim 1 of the present application. The Branson tank is large relative to the inlet and the inlet is placed far away from the chute. Any turbulence from the inflow is dissipated within a short distance from the inflow. The chute is open at the top and bottom and enclosed on its sides. The major portion of the cleaning fluid flows around the chute, as indicated by the arrows that show the flow of the water from the inflow to the outflow pipes. The top of the chute is close enough to the upper surface of the fluid

in the tank to ensure that the chute remains full of water. The continuous endless conveyor belt 24, being made of fine mesh webbing or of non-porous webbing (Branson, col. 4, lines 20 – 28), provides a barrier to the turbulent motion stemming from the inflow and prevents the turbulence from moving up into the chute from the bottom. See particularly Branson, FIGS. 1 and 2. The conveyor belt 24 extends almost the entire length of the tank, from the wall 33 to well past the bottom of the chute, close to the unmarked wall which holds the outflow pipe, and extends the width of the tank, beyond the boundaries of the chute 18. The flow from the inlet is insufficient to generate turbulent flow in the chute, to the degree necessary to generate ultrasonic levels for cleaning purposes.

7. Dropping gravel simultaneously into the chute does have some effect on the fluid, but does not produce the turbulent flow that is necessary to generate ultrasonic energy, as will now be explained. Initially, the gravel hits the surface of the fluid with a certain amount of kinetic energy. This energy (mass x gravity) is small and dissipates completely after dropping only a very short distance into the fluid. Thus, it imparts no significant acoustic energy to the fluid. The falling of many pieces of gravel onto the surface of the fluid is similar to that of rain on a pond. Dropping a single stone in a still pond (a coherent medium) creates ripples that travel a long distance away from the stone, because the coherent medium passes energy from particle to particle. The same stone dropped into the pond on a windy day or during a rainstorm, however, will produce no noticeable effect, because the waves of energy abounding in the pond from the wind or the rain drops create "acoustic noise", that is, the randomly generated waves interfere with each other and, to a large extent, cancel each other out. The choppy water is an incoherent medium and does not pass the energy from particle to particle. The acoustic noise of many pieces of gravel falling into the chute does not

have an additive effect that increases the sonic energy, but rather, has a damping effect on the wave energy, in other words, the turbulence interferes with the ultrasonic energy.

8. Next we consider the effect of the gravel once it is in free-fall in the fluid. The following equation is derived from Bird, Steward, and Lightfoot's Transport Phenomena, Chapter 6, equation 6.3-23 on page 195, which is attached as Exhibit "A".

$$v^3 = \frac{4}{3}\frac{\mathrm{Re}^{3/5}}{18.5}\frac{g\rho}{\mu}\left(\frac{\rho_s - \rho}{\rho}\right)$$

whereby $v$ is the terminal velocity (cm/s), $g$ is acceleration of gravity (980 cm/s$^2$), $\rho$ is the density of water (1 g/cm$^3$), $\rho_s$ is the density of the gravel (assumed 3 g/cm$^3$), $\mu$ is the viscosity of water (1 centipoise), and Re is a dimensionless Reynold's number given by

$$\mathrm{Re} = \frac{2Rv\rho}{\mu}$$

whereby $R$ is the gravel radius, which is assumed to be 1 cm.

9. For a piece of gravel of 1 cm diameter, for example, the terminal velocity is calculated to be 2.6 cm/s and the Reynold's Number Re to be 516. Flow in a cylindrical conduit is generally considered to be turbulent at Re > 2100; flow at less than that number is considered to be non-turbulent.

10. The above calculations assume that the water is stagnant. This is certainly not true, because, as the gravel falls downward, it pulls some of the surrounding liquid along with it. Thus, the falling gravel will draw liquid down through the chute, where it is forced out the bottom, causing some liquid flow from top to bottom in the chute, along

with the gravel. Vorticity (velocity corresponding to the curl of the flow) arises from a difference in velocity between the gravel and the liquid surrounding the gravel. The liquid or water, however, will be traveling at the same speed as the gravel, and, therefore, creating no or only minimal vorticity. This has a diminishing effect on the turbulence, reducing the Re number even further. Since flow was non-turbulent to begin with, this diminishing effect due to a decrease in vorticity further supports the statement that the statement that the flow of liquid in the Branson chute cannot produce the turbulence needed to create the acoustic energy at ultrasonic levels for cleaning the gravel.

11. Examiner asserts that turbulent flow is inherent in the Branson device and that that turbulent process flow "is capable of causing the oscillatory means to vibrate." The structural elements of the Branson apparatus, such as the walls of the tank and the continuous conveyor belt, the arrangement of the inlet and outlet pipes, plus the free-falling supply of gravel into the chute, actually prevent turbulent flow in the chute and certainly prevent a turbulent flow that is capable of creating acoustic energy flow in the chute, which is where the cleaning operation takes place. Applicant submits that Branson does not disclose a device that has the structural elements to create acoustic energy from turbulent process flow and, furthermore, that the Branson apparatus is inherently incapable of creating a turbulent flow from the process fluid (cleaning fluid). The ultrasonic energy created in the chute for cleaning the gravel is produced by the acoustic transducers, which are driven by an external acoustic generator.

12. Examiner further asserts in section 7 on page 6 that the fluid in the Branson device "is capable of being sanitized or homogenized by the device." The Branson cleaning fluid collects the dirt, debris, contamination, that is removed from the particles

and items to be cleaned. Scum collects on the top of the cleaning fluid, which is drained off via the outlet pipe. The cleaning fluid must be treated in a separate process unrelated to the cleaning process "to remove the impurities that it takes up during the cleaning process." Branson, col. 3, lines 57 - 64. Branson does not disclose any elements that work on the cleaning fluid to sanitize it and clearly states that the cleaning fluid collects the impurities that are removed from the items or particles to be cleaned in the cleaning process. Branson also discloses no elements that are capable of homogenizing the cleaning fluid. Homogenization requires that large globules be broken into smaller globules, so that they remain in suspension longer. This process requires forces be applied to the fluid that shear the globules apart. There is no discussion of any structural features that apply such forces to the cleaning fluid.

13. Applicant has shown that the flow of the cleaning fluid through the tank cannot possibly generate the necessary acoustic energy to homogenize or sanitize the fluid. For the sake of argument, let's assume that the gravel itself is the agent that is supposed to be homogenizing the process fluid. Because flow is possible through the chute from top to bottom, fluid will tend to move with the gravel, rather than resist the forces applied by the gravel. In other words, the gravel falling through the fluid will not apply the strong shear forces to the globules in the fluid that are necessary to homogenize the fluid. Applicant submits that the Branson apparatus is inherently incapable of sanitizing or homogenizing the cleaning fluid.

14. Applicant further notes the difference between the Branson apparatus, which requires a plurality of acoustic transducers, driven by an external ultrasound generator, to be operated within the cleaning fluid, and the device according to the present application, which is itself the acoustic transducer that uses the flow of the process fluid

to generate the acoustic energy to work on the process fluid. Claim 1, as previously presented, claims an acoustic device that produces turbulent flow in a process liquid, the turbulent flow causing the oscillatory means to vibrate, thereby converting a flow energy of said process liquid to an acoustic energy that works on said process liquid.

15. Branson does not anticipate the device of the present application, as claimed in claim 1, because Branson does not have structural elements that enable it to use the turbulent flow of the process liquid to generate the acoustic energy for cleaning the process liquid. Applicant submits that Claim 1 is clearly distinguishable from Branson and therefore, requests that Examiner withdraw the rejection based on Branson of Claim 1 and all of its dependent claims 2 – 14.

16. Examiner rejected claims 7 – 13 as being anticipated by Branson, asserting that Branson discloses, among others, a pair of piezoelectric members that emit acoustic waves that travel in a direction transverse to the longitudinal direction of the tank, that there is a flow partition disposed between the piezoelectric members, the flow partition being capable of extending in a direction parallel to the longitudinal axis of the tank. Applicant notes that claims 7 – 13 depend directly or indirectly from claim 1 and that the arguments presented above with regard to claim 1 also apply to these claims, which contain the allowable subject matter of claim 1. First of all, Branson does not have an expanded flow area. The flow through the chute is downward and there is no expansion between the location of inflow and the diameter of the chute. As discussed above with regard to claim 1, Applicant has shown that the fluid 12 between inlet 14 and outlet 16 is not capable of causing the Branson piezoelectric members to vibrate. Branson does not disclose, teach, or motivate one to install a flow partition that extends in a direction parallel to the longitudinal axis of the tank. Applicant submits that the Branson

apparatus does not anticipate the device of the present invention because it does not disclose all of the elements of claims 7 – 13.

17. Examiner further asserts with regard to claims 7 – 13, that Branson is capable of performing homogenizing and sanitizing on fluids. See the discussion above with regard to claim 1 and the sanitization or homogenization of fluids. The cleaning fluid of Branson is not cleaned in the Branson cleaning process, but rather, collects debris and contamination from the particulates or small items that are cleaned. The cleaning fluid itself must be cleaned in a separate, external cleaning process (filtering, distilling, or by other processes). Applicant requests that Examiner withdraw the 35 U.S.C. § 102(b) rejection of claims 7 – 13 and allow these claims.

18. Examiner rejected claim 14 as being anticipated by Bitsakis et al, U.S. Patent 5,327,941, asserting that Bitsakis discloses creating a turbulent flow, forcing the turbulent flow through oscillatory means, the turbulently flowing process fluid causing the oscillatory means to vibrate, thereby producing acoustic energy, and then forcing the process fluid and the inherently generated acoustic energy through a non-linear flow path. The purpose of the Bitsakis device is to reduce flow and avoid the creation of undesirable vibrations and noise. Bitsakis, col. 2, lines 2 – 5.

19. Claim 14 of the present invention as currently presented recites the steps of: providing oscillatory means that are prone to vibrate; creating turbulent flow on a process fluid; forcing the turbulently flowing process fluid to flow through the oscillatory means, the turbulently flowing process fluid causing the oscillatory means to vibrate, thereby producing acoustic energy; and forcing the process fluid and the acoustic energy through a non-linear flow path, thereby using the acoustic energy to do work on

the process fluid. Bitsakis does not disclose a method of doing work on a process liquid, using oscillatory means that are prone to vibrate, in addition to the other steps.

20. Applicant submits that Bitsakis does not anticipate claim 14 and requests that Examiner withdraw this rejection and allow claim 14.

21. **35 U.S.C. § 103(a) Rejection:** Examiner rejection claims 2 – 6 as being unpatentable over Branson and further in view of Hall, U.S. Patent 4,428,757. With regard to Branson, see the discussion above of the rejection of claim 1. Examiner asserts that Hall teaches a plurality of baffles with through-holes, and that it would have been obvious to place the baffles of Hall into the housing of Branson.

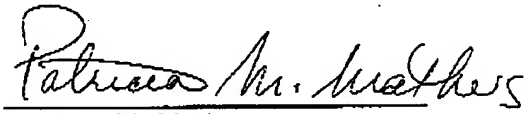
22. Claim 2 of the present application depends from claim 1 and recites, among other features, the oscillatory means (of claim 1) that includes a plurality of baffles. The baffles are part of the oscillatory means, which are assembled within the housing and which are acted upon by the process liquid to vibrate, so as to generate acoustic energy that then works on the process liquid. Neither Branson nor Hall teach, suggest, or motivate a person of ordinary skill in the art to construct oscillatory means within a flow passage, wherein the oscillatory means are caused to vibrate by the process liquid flowing through the flow passage. Both Branson and Hall teach away from this invention, because both show transducers, energized by some external sound generator, that generate acoustic energy that is then applied to the fluid. Furthermore, claim 2, as well as claims 3 – 6, depend directly or indirectly from claim 1 and, thus, contain the allowable subject matter of that claim.

23. Applicant submits that Branson or Hall, either individually or in combination with each other, do not disclose all the elements of the claimed invention. Consequently,

they do not, and cannot, either individually or in combination, teach, suggest, or motivate one to combine the elements of each disclosure to achieve the invention of the present application. Applicant requests Examiner to withdraw this obviousness rejection and allow claims 2 – 6.

24. This paper is being filed within the second month of the Final Office Action. No additional fees are due.

Respectfully submitted,



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Enclosed:
Exhibit "A"

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